CLAIMS

1/ A method of attenuating external origin noise reaching the eardrum, the method being of the type in which each ear is associated with passive soundproofing means (1g, 1d) which, together with the ear, delimits a cavity (10), and in which there are disposed inside said cavity an electro-acoustic transducer (6) and a microphone (8) which are interconnected by a feedback loop including a constant gain amplifier (11) and a filter (12), thereby constituting an active soundproofer, the method being characterized in that the transfer function C(w) of said filter (12) is a complex polynomial function and in that the open loop transfer function H(w) of the assembly constituted by the transducer (6), the microphone (8), and the cavity (10) delimited by said passive soundproofing means and the ear is measured, the coefficients of said polynomial function C(w) then being calculated so that the product of the constant gain K of said amplifier (11) multiplied by the modulus of said open loop transfer function $|H(w)|$ and by the modulus of the transfer function of said filter $|C(w)|$ is much greater than unity over the range of frequencies where said passive soundproofing means is of low effectiveness while retaining stability in the feedback system.

2/ A method according to claim 1, characterized in that in order to measure said open loop transfer function H(w), said amplifier (11) and said filter (12) are disconnected, an electrical signal corresponding to white noise is applied to the input (A) of said transducer, and said transfer function is measured by means of a spectrum analyzer which simultaneously receives said electrical signal and the signal emitted by said microphone (8).

3/ A method according to claim 1, characterized in that said open loop transfer function H(w) is modified by a partition (7) subdividing said cavity (10) into two half-cavities, a front half-cavity being delimited by the pinna (4) of the ear, the external ear duct (3), the eardrum (16), and said partition

(7), and a rear half-cavity delimited by said passive soundproofing means (1) and said partition (7), said partition (7) carrying said transducer (6), and said microphone (8) being placed in said front half-cavity as close as possible to the emissive face of said transducer (6).

4/ A method according to claim 3, characterized in that the volume of said cavity (10) is reduced as much as possible in order to "linearize" said open loop transfer function H(w).

5/ A method according to claim 3, characterized in that an annular part (15) delimiting an intermediate cavity (15a) is interposed between said partition (7) and the pinna (4) of the ear, and in that the shape and the dimensions of said annular part (15) are designed so that it performs acoustical filtering enabling said open loop transfer function H(w) to be given a low-pass filter function or a bandpass filter function depending on the range of frequencies to be attenuated.

6/ A method according to claim 1, of attenuating externally originating noise by active soundproofing means placed at the inlets to ears while enabling a message transmitted via an electro-acoustic path to be heard, the method being of the type in which the electrical signals conveying said messages are mixed with the signals emitted by said microphone and in which said mixed signals are applied to said transducer (6) after passing through said amplifier (11), the method being characterized in that said mixed signals also pass through said filter (12).

7/ Apparatus for attenuating externally originating noise reaching the eardrum, the apparatus being of the type including passive soundproofing means (1d, 1g) which together with each ear delimits a respective cavity (10), and also including an electro-acoustic transducer (6) and a microphone disposed inside each said cavity and interconnected via a feedback loop including a constant gain amplifier (11) and a filter (12) with

which they constitute an active sound attenuator, the apparatus being characterized in that the transfer function C(w) of said filter is a complex polynomial function and in that the product of the constant gain K of said amplifier (11) multiplied by the modulus |C(w)| of the transfer function of said filter and by the modulus |H(w)| of the open loop transfer function as measured at the input (A) to said transducer (6) and at the output (B) from said microphone (8) is considerably greater than unity throughout the range of low audio frequencies which are to be attenuated and satisfies the stability criterion for all audible frequencies.

8/ Apparatus according to claim 7, characterized in that said filter (12) comprises one or more analog filters of the bandpass or bandpass and lowpass type which are connected in parallel and which provide a transfer function suitable for avoiding instabilities in the zone where the modulus is greatest.

9/ Apparatus according to claim 7, characterized in that said filter comprises a plurality of analog filters of the low-pass, bandpass, and high-pass types, which filters are connected in parallel and have the same cutoff frequency and the same Q factor.

10/ Apparatus according to claim 7, characterized in that the gain K of said amplifier (11) is positive and in that the transfer function C(w) of said filter is determined such that the phase (ϕ) of said transfer function does not pass through the value zero in the pass band of said filter.

11/ Apparatus according to claim 7, of the type in which each of said cavities includes a transverse partition (7) which divides it into two half-cavities, namely a front half-cavity and a rear half-cavity, said partition carrying said acoustic transducer, and in which said microphone (8) is disposed in said front half-cavity, the apparatus being characterized in that it further includes an annular part (15) which is

interposed between said partition (7) and the pinna (4) of the ear and which delimits an intermediate cavity (15a), with the dimensions of said annular part (15) being designed so that the ratio between the dimensions of said intermediate cavity and of said front and rear half-cavities gives rise to acoustic filtering having a pass band corresponding to the range of frequencies to be attenuated.

12/ Apparatus according to claim 7, characterized in that said microphone (8) is placed in the external ear duct (3) and said transducer (6) is a miniaturized transducer whose covering on its rear face forms a plug which is engaged in the inlet to the external ear duct (3) such that said cavity is reduced to the volume delimited by the outer ear duct (3), the eardrum (16), and the transducer (6), and such that the open loop transfer function H(w) is highly linear, enabling a good level of attenuation to be obtained over a wide frequency band by electronic filtering.

18 ~~13~~/ Apparatus according to claim ~~8~~ 17, characterized in that said filter further includes one or more high-pass filters connected in parallel with said low-pass filters and said bandpass filters.